element

PHARMACEUTICAL TESTING
USP <660> CONTAINERS-GLASS

TESTING GLASS CONTAINERS FOR THEIR HYDROLITIC RESISTANCE TO PROTECT MEDICINAL PRODUCTS

CONTENTS

BACKGROUND

The safety and effectiveness of any pharmaceutical product is inextricably dependent upon its packaging. Containers and container closures must not interact physically or chemically with the substance in any way that would alter its quality. They should retain a drug's therapeutic efficacy from the time of packaging until it is consumed.

The United States Pharmacopeia (USP) enforces rigorous testing requirements for containers and their closure system. Specifically, the General Chapter <660> entitled "CONTAINERS-GLASS" outlines specific qualification tests based upon the type of glass being used for containers that are intended to come into direct contact with pharmaceutical formulations.

The quality of the glass containers is defined by measuring their resistance to chemical attacks.

Containers that do not meet the requirements of the compendia may compromise the quality of the drug product and may prevent the legal marketing and distribution.

Testing glass containers for their chemical stability is a critical step in understanding the biological safety and suitability of a container for a certain drug product. USP compliant testing ensures containers meet prescribed standards and safeguard the drug's integrity.

GLASS TYPES

Glass has a long history of use with a variety of pharmaceutical products due to its advantages over other materials; being chemically inert, impervious to air and moisture, highly transparent and long lasting. It also has excellent barrier properties, which make it particularly suitable for parenteral formulations.

Throughout the pharmaceutical industry, there exists three types of glass containers. Glass is designated a particular type only when it complies with the requirements of the specified pharmacopeia.

Glass used for pharmaceutical containers is either borosilicate glass or soda-lime-silica glass.

Borosilicate glass contains a significant amount of boric oxide, aluminum oxide, and alkali and/or alkaline earth oxides in the glass network. This chemical composition gives borosilicate glass a high hydrolytic resistance (i.e., chemical resistance of the glass to water attack under precise conditions) and a high thermal shock resistance. It is classified as Type I glass.

Soda-lime-silica glass is a silica glass containing alkaline metal oxides (primarily sodium oxide) and alkaline earth oxides (primarily calcium oxide) in the glass network. For this reason, it has a moderate hydrolytic resistance; hence, it is classified as Type III glass. Appropriate coating treatment of the inner surface of Type III soda-lime-silica glass will raise the level of hydrolytic resistance from moderate to high, changing the classification of the class from Type III to Type II.

Based on their hydrolytic resistance, recommendations can be made on the suitability of the glass type for containers that are used for pharmaceutical products.

CONTAINER TYPE	USE
Type I	Suitable for most preparations, whether or not for parenteral administration.
Type II	Suitable for most acidic and neutral formulations or for aqueous products, both for parenteral and non-parenteral uses. May be used for alkaline parenteral products where stability data demonstrate their suitability.
Type III	Normally not used for parenteral products or for powders that will be reconstituted and used parenterally, except where suitable stability test data indicate that Type III glass is adequate.

THE REGULATION

The United States Pharmacopeia (USP), through its stated mission of "Improve global health through public standards and related programs that help ensure the quality, safety and benefits of medicines and foods" is responsible for guiding the industry to safe and effective product development.

A key part of the product development process is the container and package system that is used to deliver the product.

Glass containers for pharmaceutical use must comply with USP <660> CONTAINERS-GLASS. This chapter covers the testing required for glass containers that come into direct contact with pharmaceutical products. In particular, it deals with the Glass Grains Test and the Surface Glass Test for hydrolytic resistance.

Hydrolytic resistance is determined by the quantity of alkali released from the glass after autoclaving glass containers filled with purified water under specified conditions. The smaller the quantity of alkali, the more resistant is the glass. The Glass Grains Test combined with the Surface Glass Test determines the glass type.

The Glass Grains Test distinguishes Type I borosilicate glass from Type II and Type III soda-lime-silica glass.

The Surface Glass Test determines hydrolytic resistance of glass inner surface (i.e., contact surface for pharmaceutical preparations). It defines the quality of the inner surface by distinguishing between Type I and Type II containers with high hydrolytic resistance and Type III containers with moderate hydrolytic resistance.

An additional Surface Etching Test may be performed to determine whether high hydrolytic resistance is due to chemical composition of the glass container or to inner surface treatment.

Glass containers must comply with their respective specifications for identity and hydrolytic resistance in order for them to be classified as Type I, Type II or Type III. The type of glass being used is paramount for the quality, safety and stability of the drug product. This is why several packaging chapters within the U.S. Pharmacopeia are constantly being revised and updated.

As of May 2015, the requirements for General Chapter <660> CONTAINERS-GLASS have changed. The Glass Grains Test has now to be executed by heating the glass in contact with water at a temperature from 100°C to 121°C at a rate of 1°/min within 20-22 minutes. From the time when the holding temperature is reached, temperature must be maintained at 121 ± 1° for 30 ± 1 min followed by cooling to 100° at a rate of 0.5°/min within 40-44 minutes.

These new specifications allow a more precise classification of glass containers. Selection of the appropriate container for a given drug formulation will provide added assurance of drug integrity and stability of quality medicines.

CONCLUSION

All medicinal products need to be protected and consequently packaged in containers that conform to prescribed standards. Failure to meet the compendial requirements may compromise the integrity of the drug product, resulting in a serious public health hazard.

Element is a global provider of testing, inspection, and certification services for a diverse range of materials and products in sectors where failure in service is not an option. Everything we do is designed to deliver one thing for our customers -certainty that the materials and products we test, inspect, and certify are safe, quality, compliant, and fit for purpose.

With over thirty years experience in pharmaceutical testing, our laboratories assists our clients in demonstrating compliance with the respective compendial standards, identifying impurities and assessing the integrity of pharmaceutical packaging components and container materials.

With a state-of-the-art testing apparatus and extensive expertise, we are able to support you in conducting specific tests for hydrolytic resistance on your glass containers in accordance with USP <660> CONTAINERS-GLASS.

Our team of highly experienced scientists will help you meet the updated container regulatory requirements, thus ensuring the highest level of product quality and efficacy.

REFERENCE

USP <660> CONTAINERS-GLASS
www.uspnf.com

U.S. Pharmacopeial Convention
www.usp.org

Contact.us@element.com Europe: **+44 (0) 808 234 1667** Germany: **+49 800 000 5137** Americas: **+1 888 786 7555** - **www.element.com**

E150060819